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Towards Representation of Real Entities using Holographic Technology

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Abstract: In recent years, augmented reality (AR) has received a lot of interest and development. For a number of reasons, it is not just exploited for entertainment but also for a variety of applications. It allows users to involve themselves in realistic environments and experiences that would otherwise be impossible to achieve in the real world. By overlaying the virtual images onto real-world objects, augmented reality (AR) provided the user with more information. A holographic display may be able to deliver a simulated three-dimensional object containing depth information. However, creating a tiny holographic display with a wide viewing angle and sufficient resolution is difficult. Due to which a lot of important events are not completed due to the unavailability of participants in a realistic manner. Moreover, the emotions of the speakers are not replicated as present in real-time speeches. Holog Reality (HR) utilizes a glass of precise dimensions to pretend the real object as a virtual object. This research work also proposes and implements an object creator algorithm for a more accurate presenter's view. The work has also focused on implementing augmented reliability for e-learnings, remote conferences, keynote speakers and various types of interactive physical environments.

Keywords: Holog reality, Holographic glass, 3D projection, Object Projection, Holog conference.

1. Introduction

The term "Technology" refers to convenience, and currently, virtual and augmented reality are trendy technologies. However, transforming real-world objects into digital representations can be challenging. A possible solution to this problem is a concept called "Holog Reality," which involves using hologram-based projections to create virtual replicas of real-world objects. Three-dimensional holographic projection technology is loosely based on an illusionary technique called

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Peppers Ghost [1] [2] [3]. "Holog Reality" is a solution to the challenge of arranging keynote speaker sessions at conferences. It allows for the projection of physical objects during a video call with realistic gestures and motions, providing a more convenient and accessible option for both speakers and attendees. [4] [5] [6]. Holog reality will be used in all business organizations, seminars, concerts, political gatherings, and for conducting lecture sessions in addition to international and government conferences (APCs) [7] [8]. This solution is a technological improvement that will create a product, be business-oriented, and focus on serving organizations. The main HR features in this regard are as follows:

- The session of presentation could be held by starting a live video call between multiple speakers. The system support to play a recorded video of variety of resolutions and frame sizes.
- A hologram glass of proposed system can project a video recorded from four sides of the object.
- Offers playback, pausing, ending, and other video control options to the user. Users may also choose to record the online session on video.
- With the fewest possible delays, mimic all of an object's movements and gestures.

If a live communication presentation session is being planned, the presenter should be in front of a black background. Use a camera with at least 8 megapixels if the video quality is good to get a good projection of the object. In live sessions, the projected participant should not be outside the designated area. In order for the audience to easily visualize holographic reality, the projection of a person must be at least 4 to 5 feet tall.
The main objective of this research work is to provide a platform for remotely participating in events/environments where the user is not able to be present physically. In all such environments, this solution provides a real-like representation of the presenter in a real-time physical environment. This research work provides a four-sided view of the presenter so that attendees get the feel of the real presence of the presenter. This also includes an efficient representation of the speaker’s emotions in the speech.

2. Literature Reviews

Due to its potential to develop into the next-generation display and radically alter how we live our daily lives, augmented reality (AR) has attracted unprecedented research interest in both academia and industry. The fundamental idea behind augmented reality is to smoothly merge digital simulations of real world environments. Even though the VR/AR sector has advanced significantly since its inception, it is still in the early stages of growth [9] [10]. There are still several issues, such as the exorbitant pricing, the dearth of content, and the poor display quality. Fortunately, the growth of the smartphone sector has led to decreases in price, size, and performance of sensors and displays, which will pave the way for future advancements in VR/AR [11] [12].

However, the existing AR application is displayed on a smartphone's tiny screen, where only a limited amount of information can be shown. This makes it challenging for the user to view the content on the screen. Moreover, in order to observe the virtual items displayed on the device's screen, users must always hold their smartphones or tablets and aim them at an image target. Additionally, many AR systems only permit one user at a time to view the AR object, creating a socially isolated user experience. These problems make sharing digital content and human-computer interaction challenging. Additionally, holographic pyramid applications recently have only supported static exhibition displays where users cannot interact with the holographic display [13] [14].

In the existing literature, multiple applications are focusing on the virtual representation of the presenters. Some of the research works targeted kids' training with the help of virtual reality [15]

Table-1: Comparative Analysis of Proposed Approach and Existing Literature

Features	Skype	Google+Hangouts	Holoplayer	Holapex Hologram	Holog Reality
Conference Calling	Yes	Yes	No	No	Yes
Four Dimension Screen	No	No	Yes	Yes	Yes
Object Projection	No	No	Yes	Yes	Yes
Multi-node Connection	Yes	Yes	No	No	Yes
Action on Gestures	No	No	No	No	Yes
Recording	No	No	No	No	Yes

[16]. These approaches have moved towards augmented reality for the applications of newscasting, digital advertisement and entertainment [17] [18] [19] [20]. But, these applications have not much contributed to the areas of education, learning, emotion-based human interaction and enhanced multi-dimensional presenter view. In this connection, one of the most commonly used online meeting platforms is Skype [21] [22]. Multiple locations can benefit from its calling and conferencing support, but this application lacks the ability to project real objects or record online sessions in real- time. Another option, cited as application [23], offers a fast and easy way to set up and run a free conference call. However, this option does not support recording online sessions or projecting objects. Application [24] is designed to display holograms on smartphones, requiring a glass or transparent pyramid placed upside down on the phone. By playing a video using the app, the pyramid's reflection creates the illusion of a 3D shape. Unfortunately, this application does not support video calling or conferencing. Another application [25] allows users to easily convert videos or pictures from their device into a hologram video, usable with homemade holograms and specifically designed for Holapex Vivid and Holapex Light Pyramid holograms. No coding or difficult editing is required - simply select the video or picture from the device and convert it into a usable video for the Hologram Pyramids. However, this application also does not support video calling or conferencing.

In continuation with the existing approaches, the following research gaps have been identified.

- Presently used applications do not provide a real representation of human entities with actual emotions.
- In a situation, where a multi-sided view of an entity is needed i.e. conference presentations, virtual learning or crowded events. The existing approaches are unable to provide such a clear view from all sides.

3. Methodology

The aim of the research is to provide a system that projects an entity as a real moving object from a remote location in a situation where the entity is unable to participate physically in a session. Holog reality provides users with the ability to conduct online sessions using any video calling application. When the user is connected to the video call, this application converts the incoming video into a four-sided screen and wirelessly transmits it (using an intermediate server) to the hologram projector. The projector then projects the incoming moving object's image onto each side of the hologram, creating the illusion of a real entity inside the glass. The system model for this process is represented in Figure 1 and explained in further detail below.

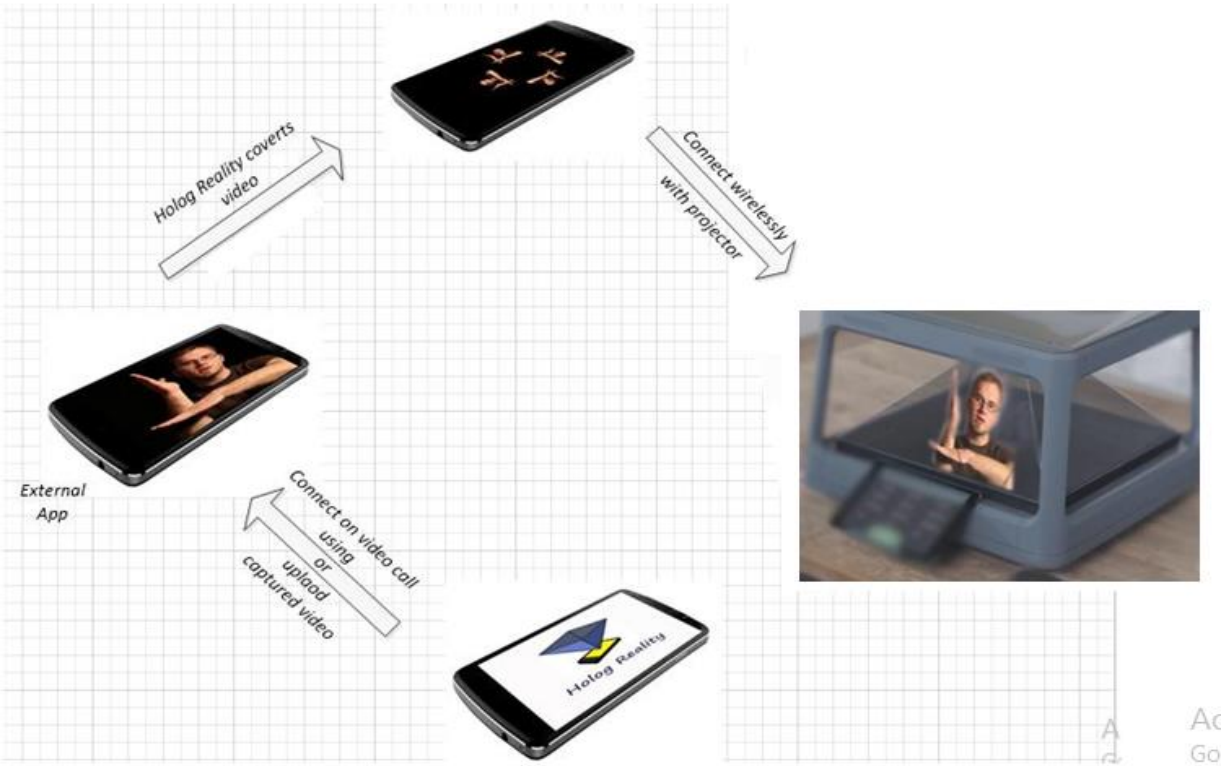

Fig. 1- Proposed Model of Holog Reality System

System Architecture— The system architecture for Holog reality comprises of hardware and an application, as shown in Figure 2. The hologram itself is made up of four specific glasses with predetermined height, width, and shape. The size of the hologram can be adjusted based on the user's needs, such as using larger values to project a presenter in a conference or smaller values for an object attending a meeting. The system utilizes the following formulas to increase the size of the hologram.

Formula:

Height of the Glass = X * 4.5cm
Bottom width of the glass = X * 6cm
Top glass width = X * 1cm

Where X = 1, 2, 3, 4

4. Functions of Holog reality application

4.1 Support for conferencing and Video calling

Holog reality is a generic solution that supports all video calling and conferencing apps to facilitate users to generate holographic moving objects from live video calls. In a situation where a conference is arranged and presenters from different remote locations want to participate in the conference. The system will pretend the presenter as real objects from the remote location without attending the conference physically. Holog reality applications provides the opportunity to the users to connect a video call among multiple users simultaneously. The system can project multiple holographic 3D objects at a time. This unique function makes the solution fast and cost effective.

4.2 Four-sided view

The system provides a hologram glass to project four-sided view of real objects of all online and offline videos

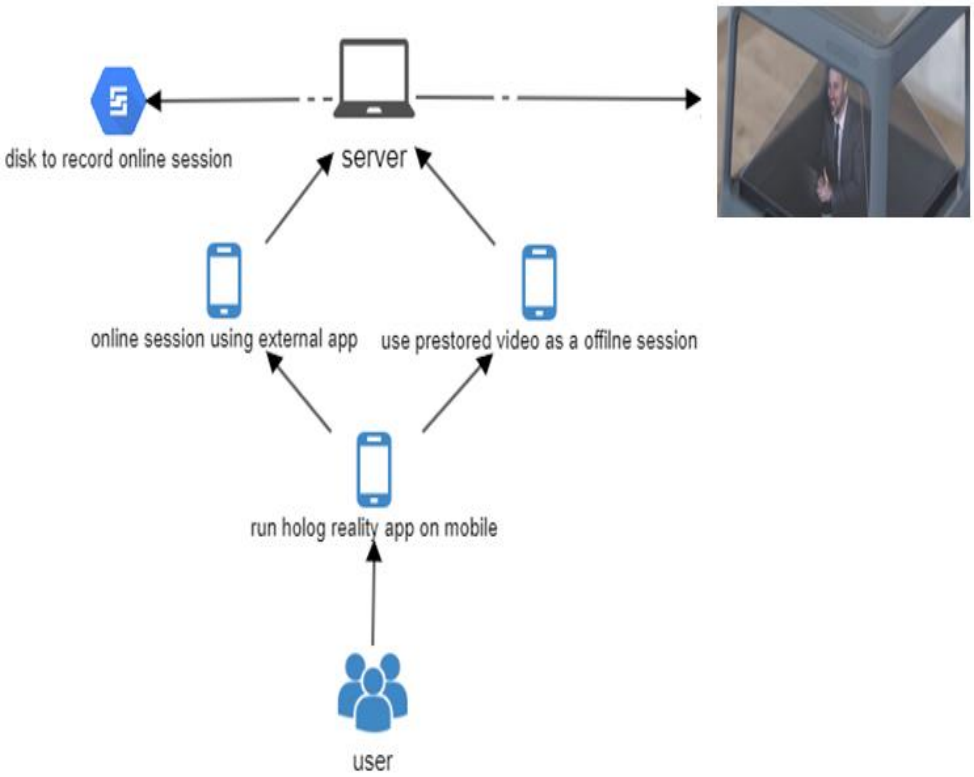

Fig. 2- System Architecture of Proposed Application

To initiate the session, the user can start the session by connecting with proposed application. When the viewing time comes, the screen will be split into four equal-sized sides. The image was displayed for best watching whenever a space became accessible. The axis would be disseminated in the form of x-axis and y-axis i.e. the ranges from 0^o to 90^o, 90^o to 180^o, 180^o to 270^o and 270^o to 380^o may be set. The picture will be displayed with a fine display and outcome when the Holog glass is put over the apparatus. Users will believe that the individual in the picture is genuine and actually there. From every angle, the displayed picture would be as clear and precise as your vision. If the glass and gadget were positioned in the middle of the table, everyone would be able to see the picture. Additionally, Figure 3 displays specifics regarding glass size and style.

4.3 Projected object size

The system is enable to generate holographic object of any size depending on the situation to make it more representative and to increase the visualization of users. The size of projected object can be changed to achieve the best result from the system. The proposed application required a wide variety of image sizes to project a quality output. On the other hand, the system is also permits to be used in various fields for the same purpose. For example it can remotely display business level presentations to introduce various products. The projected image size depends on the size of the glass and device. To meet the requirements of the user, the system provides a variety of video qualities.

4.4 User control

The users will have access to fundamental features including uploading videos and managing pause, play, and stop actions. For ease of use, we provide the user with straightforward hand motions; rather than touching the device, the user merely needs to move his hands in the air to operate. As the session begins, the user only needs to sit and take part;; all essential tasks can be accomplished with hand commands alone. It is done for the comfort and convenience of the user. The user wouldn't need to touch the device frequently throughout the session thanks to this feature's ability to gratify and relax them.

4.5 Connection between mobile device and application

In order to deliver an acceptable video output in terms of time, devices must be able to establish a connection with system's projector using a reliable link through a server. After initiating a session, this connection will improve the quality of the visualization of projected output when the user established connects with proposed external application. The projector connection's Holog glass will yield the best possible outcomes. Humans perceive the image to be immediate and physically present in front of them.

4.6 Record the Session

It is important to accurately record the online meeting. As soon as the user selects the online option, they will have the choice to record the session. As soon as the session started, your phone would

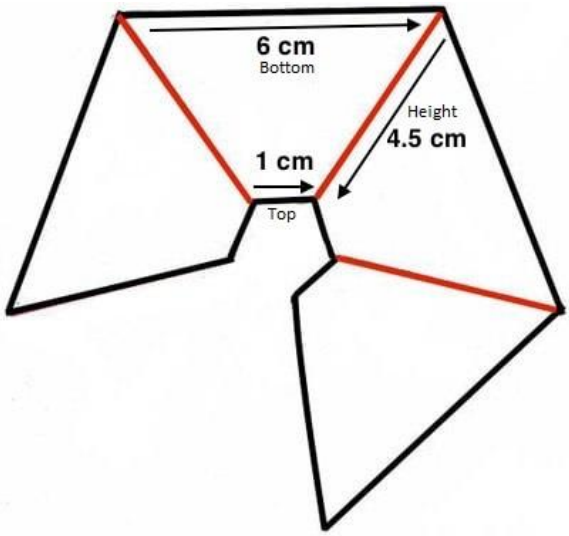

Fig. 3- Hologram Glass Design and **Measurement**

start recording it. The user experience will be greatly facilitated and made easier by this functionality. The user has the option of using or not using this function. Speakers are necessary to conduct the same conference at multiple locations and at different times due to the frequent talks and conferences held. In this connection, the speaker will benefit from this feature because only one session needs to be held, which can then be recorded and played back as needed. The audience at conferences frequently misses the points and is unable to comprehend what the speaker is focusing on, therefore it will be useful for both the speaker and the audience as well. Using this feature, the user could replay the recorded session as many times as necessary without ever missing anything.

5. Representation and Analysis

The portrayal of the Holog reality Mobile application is explained in this section. Every screen's user interface is created with the user's comfort and ease in mind, and all system functionalities are met by an easily understood and graspable graphical design. This is the user interface that loads up when Holog reality is initially launched. The Holog reality logo appears as soon as a user launches

it, indicating the commencement of the programme and displaying the software's welcome screen to the user. After a predetermined amount of time, this screen will show.
After the first interface swap, the next interface will appear. The session can be started by the user if they so wish. Also, the logo for the Holog reality application will be seen at the top of the option, highlighting the application's availability and its stress-free theme. Each age group may understand it and use it with ease. The user will be taken to the next screen as soon as they choose this option.
Another screen will appear as soon as the user chooses the option to begin the session. The interface must be simple to ensure user comfort. Once more, a calming theme will be used, and the Holog reality logo will be shown. If the user wishes to begin the session offline or online, another option will be shown to them. In contrast, if the user chooses the online option by utilising an external application, he or she will be able to begin their online session. If the user chooses offline, another screen will show after this screen, and so on, as the offline session is done.
The user must choose an external application through the Holog reality app in order to begin the session. In this regard, Figure 4 shows different user interface layouts for the application. In addition to letting users use whatever external programme they feel comfortable with, Holog reality also supports video calling and conference calling. As was already said, this feature completes function 1. Users can connect to one or more people simultaneously. It makes organising

Fig. 4- Layouts of User Interface of Holog Reality

conferences quite easy. Distance would only be a phrase if you followed the Holog reality programme user.

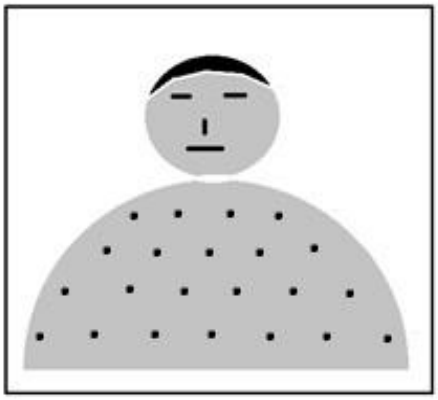

Fig. 5- Capture the Real Image

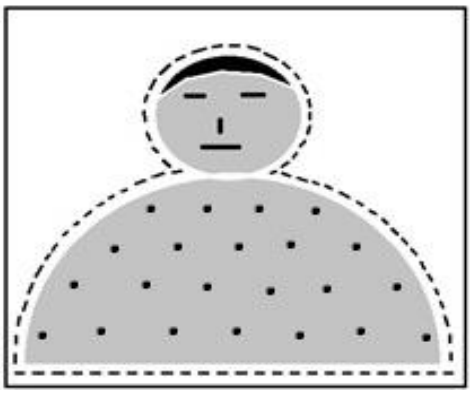

Fig. 6- Finding Edges of Object

Once connected, the user's session with the external programme would start. The user will have access to a four-sided screen view in this instance. The screen will appear on four displays, as was indicated in the section above. The user will gain from simply needing to connect through the Holog reality programme; no other methods are required. The Holog glass would be placed above this screen, giving the user the best view of the speaker inside the glass and giving the sensation that it is physically there.

6. Results and Discussions

Initially, a glass with size of 6 cm bottom, 4.5 cm hoght and 1 cm top has been desighed to project an object from a remote location. The model was integrated with poposed holog application. Firstly, a video with a resolution 480 x 270 has been played using proposed system. As a resulty the clarity of generated object was low and visibilty of the object was not satisfactory. Afterward, two videos with screen resolution of 960 x 540 and frame resolution of 1280 x 1080 have been generated respectively. The holog application has succefully played both videos. A miner delay in second video has been observed while generating artificial 3D object but the clarity of the object was satisfactory.

To achieve more accuracy and clarity, an other video with 1920 x 1080 resolution and aspect ratio of 9:16 was created and played in application. This time, a clear holographic augmented object has been presented by the system. The system showed all the dimentions of objecs in the video with actualt movement and guesture. It is observed that the quality of object projected object depends on the resolution and impact ration of the frames of the video. High resolution video creates some delay. The delay can be covered by providing high bandwidth to the sysem while playing input video from a remote location. The system has been tested with a live session. It is observed that the quality of projection depends on qualy and number of cameras used to capture the session. The major steps of the algorithm are given as under:

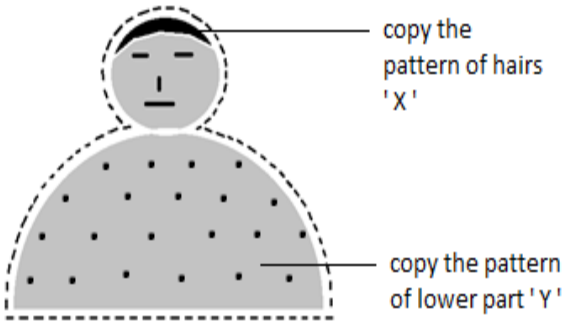

Fig. 7- Process of copying X and Y Patterns

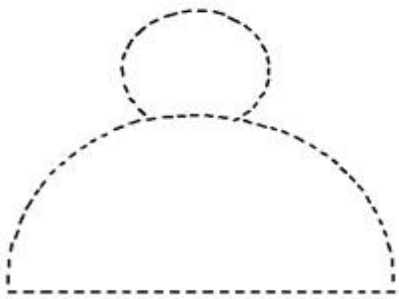

Fig. 8- Dummy Image

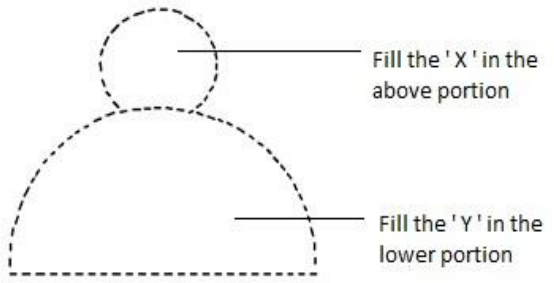

Fig. 9- Process of Filling Colours of Patterns in Particular Parts of Object

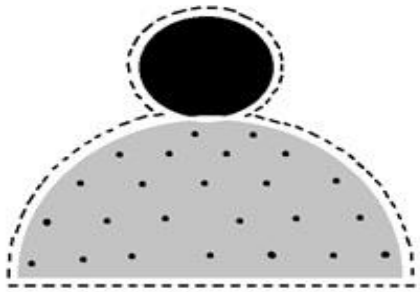

Fig. 10- Final Dummy Image of Background

Step 1: A real image represented by "i" is captured while calling video by application at run time.

Step 2: The system created a geometric model by finding the edges of the input object or picture.

Step 3: The model copy the pattern X and Y where, X= hairs and Y= lower part of the object.

Step 4: The detected edges helped the system to create a dummy image of the input object.

Step 5: The system filled the upper side of the created dummy object with a pattern copied from 'X ' (hairs) and 'Y ' representing the lower side of the object.

*Step 6: F*inally, the image is created according to the background of actual object.

The results obtained by implementing our algorithm is useful in generating holographic 3D projection real recorded and live sessions.

Table-2: Comparative Analysis of Results from Recent Studies

Features	AR using holographic display [1]	Neural 3D Holography [12]	The Holographic Future of Head Up Displays [19]	HoloPlayer [24]	Holog Reality
Multi-Participants	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Multiple Participants
Object Projection	3D Projection	2D/3D Projection	3D Projection	3D Projection	4D Projection
Holographic Clarity	Partially Clear	Very Clear	Partially Clear	Very Clear	Very Clear
Object Resizing	Not Adjustable	Not Adjustable	Not Adjustable	Adjustable	Adjustable
Gestures Integration	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Enabled
AR/VR with Holography	Integrated	Integrated	Not Integrated	Not Integrated	Not Integrated

There are extensive related studies and their qualitative and quantitative results in past years, yet there are few limitations needs to be address and there is still a prime need of solving them. We have covered few studies to compare our research project with related studies as shown in Table 2. We have took 6 primary features which any Holographic study/project should contain, and we can clearly discuss that in [1], in their 3D projection the feature of multi-participants during a conference/video call is not available for the user while they didn't focused on the clarity of Holograph, and Gesture integration, but the implementation of AR were present. Whereas [12] also produce 3D projection and didn't consider multi-participants feature during a conference/video call, but they produced a good clarity with AR/VR feature, but the resizing of object didn't applied as well as the gesture Integration. [19][24] Also produce 3D projection and didn't consider multi-participants feature during a conference/video call, but [19] made didn't focused of clarity but not

be able to adjust the size of object while [24] does focus on clarity as well as you can resize the object, and for both studies Gesture integration and AR/VR implementation are not present. In the end, our study produced much significant and far better results than other work done in the paradigm of Holography, we have achieved all the features with a positive success rate except only one which is Augmented and Virtual Reality which we are considering our Future Work to do. Still there are much dire need of practical implementation is required in the field of Holography.

7. Conclusions

In the past few years, augmented reality based projections of objects was used by the researchers. These methodologies covered 3D designs of various objects like humans, airplanes, animals etc. Holog reality provided next towards the integrated systems to artificially project moving objects which actually exists at a remote location. The idea can be used in conferences, exhibitions, education, business meeting, concerts etc. the concept of Holog reality can be implemented to generate variety of objects with different sizes depending on the size of the glass and resolution of video or image. The proposed model can cope multiple inputs to arrange a meeting or a conference in which individuals from different locations can participate. The research work also plans to expand the use of Holog reality for army weapon exhibitions so that forces do not need to take their military equipment in different areas. Further, another future direction is to target the image-based Holog presentation of the presenter.

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